BA

PATENT SPECIFICATION 1,164,281

DRAWINGS ATTACHED.

Inventor:—WILLIAM DUDLEY GILMOUR.

1,164,281

Date of filing Complete Specification: 16 Sept., 1966.

Date of Application (No. 39898/65): 18 Sept., 1965.

Complete Specification Published: 17 Sept., 1969.

Index at acceptance:—H4 U(3B, 3C); H4 L(11C, 26C4, 26C5, 26E8, 26F6, 26G1B, 26G2C).

International Classification:—H 04 b 5/00.

COMPLETE SPECIFICATION.

Improvements in or relating to Telephone User's Local Apparatus.

We, ELECTRIC & MUSICAL INDUSTRIES LIMITED, a British company of Blyth Road, Hayes, Middlesex, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to telephone-user's local apparatus of the type (hereinafter referred to as "the type specified") with which a telephone user is provided, and which can only be operational when connected by means of wires to a telephone exchange and whereby the telephone user may establish telephonic intercommunication with another telephone user.

In known arrangements, such local apparatus includes a microphone-earphone assembly in the form of a handset electrically and mechanically connected by means of a cable to a cradle unit which includes cradle means for housing the handset when not in use and which may also include other equipment as required and as convenient.

With such known arrangements, where the cradle unit is located upon a desk there is a tendency for the said cable to disturb papers upon the desk. Furthermore, the telephone user tends to be restricted to a region defined by the length of the said cable and thus may be unable for example, to carry the handset with him while he is consulting filed documents located outside of that region. It is an object of the present invention to reduce such difficulties.

According to the invention there is provided telephone user's local apparatus of the type specified, the apparatus including at least one portable microphone-earphone assembly not tethered to the remainder of the apparatus, and including intercoupling means for conveying speech signals from the or each assembly to the remainder of the apparatus and vice versa, said intercoupling means being such that the coupling in both directions is inductive.

The invention also includes a telephone system which includes at least one telephone exchange which is provided with at least one apparatus according to the invention.

In order that the present invention may be clearly understood and readily carried into effect it will now be more fully described by way of example and with reference to the drawings accompanying the Provisional Specification of which:—

Figure 1 is a block-schematic circuit diagram of a duplex inductive-loop system for carrying out the invention,

Figure 2 is a block-schematic circuit diagram of another form of system,

Figure 3 illustrates waveforms associated with the system of Figure 2,

Figure 4 is a schematic circuit diagram of a power supply system;

Figure 5 is a schematic circuit diagram of a modification of the system of Figure 2,

Figure 6 illustrates waveforms associated with the system of Figure 5,

Figure 7 is the circuit for a handset for use in the system shown in Figure 5,

Figure 8 shows another form of the circuit of Figure 7, and

Figure 9 is the circuit of the cradle-unit equipment for use with Figures 7 or 8.

Known arrangements of telephone-user's local apparatus commonly include a routing device, for example in the form of a hybrid transformer, which is so arranged that speech signals received from the telephone exchange are at least in part routed to a listen channel and thence to the earphone of the microphone-earphone as-

oscillator 17 is provided in the cradle unit and it generates uniformly spaced pulses (at a repetition rate of 50 Kc/s) which trigger a first bi-state circuit in the form of the monostable multivibrator circuit 18, whose ON time is modulated by the amplified listen signal. The loop 4 is fed directly from the output signal of the monostable 18. This output signal is inhibited from passing into the amplifier 13 during the ON period by the AND gate 19. A differentiated version of the waveform B will be picked up by the winding 5 in the handset. This is amplified in amplifier 7 and fed to a second bi-state circuit in the form of a bistable trigger circuit 20 which turns ON for a positive pulse and OFF for a negative one. The output from the circuit 20 shown by waveform D is thus a replica of waveform B. A low pass filter 21 gives an audio output, fed to the earphone 9. The leading edge of waveform D, which is fixed in time by the waveform A from the timing oscillator 17, is delayed in delay circuit 22 and used to trigger ON a monostable circuit 23 identical to that in the cradle unit, but modulated in this instance by the output from the microphone 10. The output waveform F is applied to the winding 5 and a differentiated version thereof (waveform G) is picked up by the loop 4, amplified in amplifier 13 and passed to a bistable trigger circuit 24 (identical to 20) of which the output is smoothed by the LP filter 25 and passed via amplifier 31 to the hybrid transformer 1 as the speak signal. Sidetone is provided by the hybrid transformer 1 as before. The receiving amplifier at the handset is inhibited for the duration of the transmitted pulse at that end by the AND gate 26. This type of circuit may readily be realised in integrated circuit blocks, and can thus be made far more compact than the system shown in Figure 1. If several non-interacting channels are required the transmitted waveforms B and F can be impressed on a suitable carrier frequency of the order of 500 Kc/s. However, if some increase in noise can be tolerated, it should be pointed out that what amounts to synchronous demodulation has been established, since the frequencies of different timing oscillators 17 can be staggered, and thus reasonable performance should be possible with adjacent sets of apparatus provided that the required signals are stronger than the interfering ones. Some economy in power consumption may be obtained by differentiating B and F before applying these waveforms to the loop 4 and the winding 5 respectively.

It should be noted that the fixed loop 4 may be replaced by a long ferrite-rod aerial of a length of about 18 inches; however, in a fixed installation the loop may be more easily concealed.

In passing it might be considered that one channel could use the voice-frequency currents directly. This is not so because of the differentiating effects of the loop 4 and of the winding 5 and the consequent liability to saturation by 50 c/s signals or harmonics thereof from the public electricity supply mains due to the very high low-frequency gain required.

Figure 4 shows schematically the arrangement of a suitable power-supply arrangement for taking a small current from the line and using it to recharge a suitable storage battery 29 located inside the handset, via contacts 27 which may be made while the handset is housed by the cradle means. The bridge rectifier 28 serves to connect the line DC to the storage battery 29 with the correct polarity irrespective of which way round the handset is positioned on the cradle means. The transistor Q1 is provided to otherwise disconnect the battery 29 from the handset apparatus (for example the elements 26, 7, 20, 22, 23 and 10 of Figure 2) when the handset is replaced on the cradle means, the transistor Q1 being then biassed to cut-off via the centre contact 30. While a current of about 10 mA may be drawn from the exchange line without operating the exchange relay it is quite likely that that relay will not drop out unless the current is reduced below this level; the condenser C1 with associated resistor R_1 are therefore provided to supply current to the handset immediately on replacement, the arrangement being such that the line current falls momentarily nearly to zero on replacement of the handset.

A bridge rectifier, not shown, may also be required at the input from the line to the power-supply arrangement to allow for the polarity of the exchange line to be reversed during maintenance operations on the line or at the exchange. Alternatively, a local power supply, of conventional design, fed from the 50 c/s public electricity supply mains, may be installed within the cradle unit.

The block schematic of an alternative embodiment is shown in Figure 5 and the waveforms present at the lettered parts thereof are indicated in Figure 6. In the cradle unit, a train of timing pulses is generated at a constant rate by a unijunction-transistor type of timing oscillator 32. These pulses trigger a monostable multivibrator circuit 18, whose ON time is modulated by the listen signal from the hybrid transformer 1. After amplification in amplifier 33 the output from the multivibrator is applied to a loop 4 encircling the area in which it is desired to use the handset. The loop waveform is picked up in differentiated form by the winding 34 on the ferrite rod 5 in the handset, and the start pulse, which is

N4 is the handset monostable, modulated by the output of the handset microphone, amplified in N5. Q3 and Q4 form a similar output circuit to that described above. The power lines are +5, +3, and −5V derived by Zener diodes 45 and 46.

Figure 9 shows the circuit diagram of the cradle-unit equipment which employs similar integrated circuits in the form of a type SN518A monostable circuit N_7 and a type SN 511A bistable element, N_8. The basic timing pulses are derived from the uni-junction transistor oscillator, Q1, which drives the monostable network N_7 whose output is amplified in stages Q2 and Q3 and drives the loop 4 laid round the room. Modulation for network N_7 is obtained from line, through a d.c. blocking capacitor 47 and the level may be adjusted by potentiometer RV 1. Signals from the loop are amplified in the conventional amplifier stages Q4—Q6, with stage Q7 providing suppression during the transmitted pulse. The transistor of the stage Q6 is normally bottomed, and the received signals from the handset is a negative pulse, applied to the network N_8, which has previously been set at the end of the pulse transmitted by the cradle unit. The output from N_7 is smoothed and amplified, before being passed back to line through the hybrid transformer within the cradle unit. A direct connection to the normal handset may be made through switch SW1A and SW1B so that the telephone can still be used normally if the cordless handset is removed for battery charging etc. This facility is also an aid to preserving a relative secrecy in communication. The power supply circuits may be conventional, or the equipment may be powered from the exchange battery. A good radio-frequency earth through capacitor C1 is necessary.

There will normally be no interference between adjacent sets of apparatus, provided that the corresponding loops 4 are separated by more than one loop diameter. With smaller separations, the possibility of interference will depend on such factors as the precise control of pulse repetition rate and so on, although if the pulse repetition rates of adjacent installations are locked, as can be done very simply, the possibility of interference will be much reduced. On any one installation, any number of handsets may be used and an hierarchic system of reply can be used, with users of greater priority being provided with handsets with shorter retransmission delay times, for the handset with the shortest delay time will capture the cradle-unit receiver. It will be understood that voice-operated switching of the handset transmitter will then be necessary.

Modifications may be readily made to the described embodiments within the scope of the invention. The battery charging circuit shown in Figure 4 may be modified to act by way of an electromagnetic coupling between the cradle unit and the handset in the form of a transformer in the cradle unit energised by a periodic supply. Such an arrangement would overcome any difficulty arising from a bad contact between the cradle means or cradle unit and the handset during the recharging period.

The alternative forms of the said intercoupling means, employing an optical-frequency link or an ultrasonic link, have been referred to and both these systems have the advantage that the transmit and receive paths both at the cradle unit and at the handset may be more readily decoupled, thus easing the problem of speak-listen channel separation. A said combination of different links will also show an advantage in this respect.

WHAT WE CLAIM IS:—

1. Telephone user's local apparatus of the type specified, the apparatus including at least one portable microphone-earphone assembly not tethered to the remainder of the apparatus, and including intercoupling means for conveying speech signals from the or each assembly to the remainder of the apparatus and vice versa, said intercoupling means being such that the coupling in both directions is inductive.

2. Apparatus according to Claim 1 wherein the or each portable microphone-earphone assembly is in the form of a handset.

3. Apparatus according to Claim 1 or 2 wherein the said remainder of the apparatus includes cradle means for cradling the assembly or at least one of the assemblies, when not in use.

4. Apparatus according to Claim 1, 2 or 3 wherein said intercoupling means provides a duplex system of communication between the or each assembly and the remainder of the apparatus.

5. Apparatus according to Claim 1, 2 or 3 wherein said intercoupling means provides a pseudo-duplex system of communication, in the form of a time division simplex system of communication, between the assembly or at least one of the assemblies, and the remainder of the apparatus.

6. Apparatus according to any preceding claim including means for providing said speech signals to said intercoupling means in the form of pulses.

7. Apparatus according to Claim 6 wherein said speech signals are provided in the form of width modulated pulses.

8. Apparatus according to any of Claims 1 to 6 wherein said speech signals are provided in the form of pulses the times of occurrence of which are varied.

1164281 PROVISIONAL SPECIFICATION
6 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 1

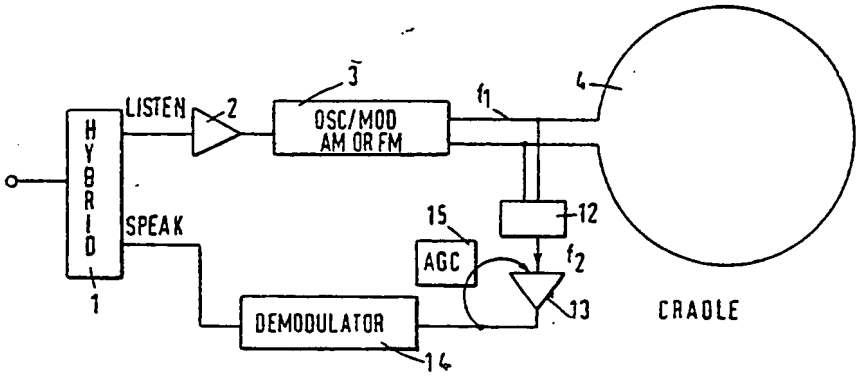


FIG. 1

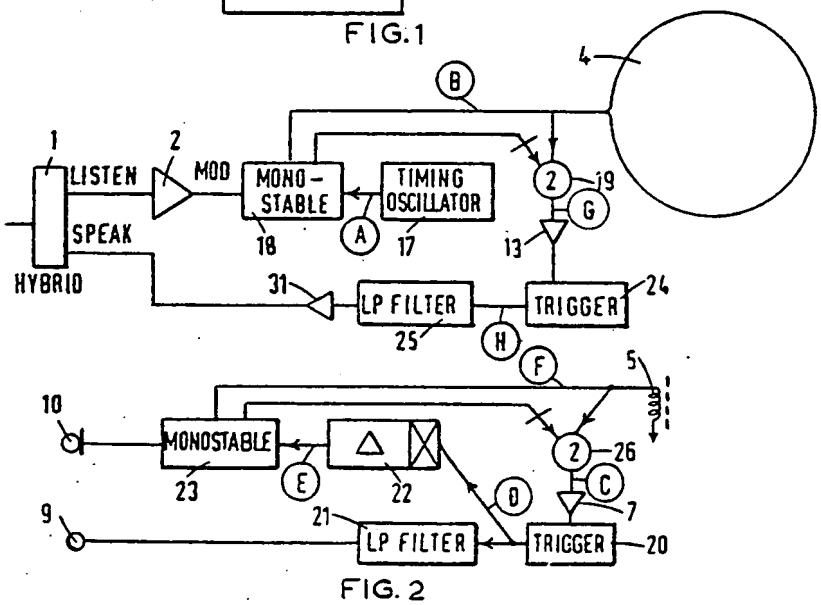


FIG. 2

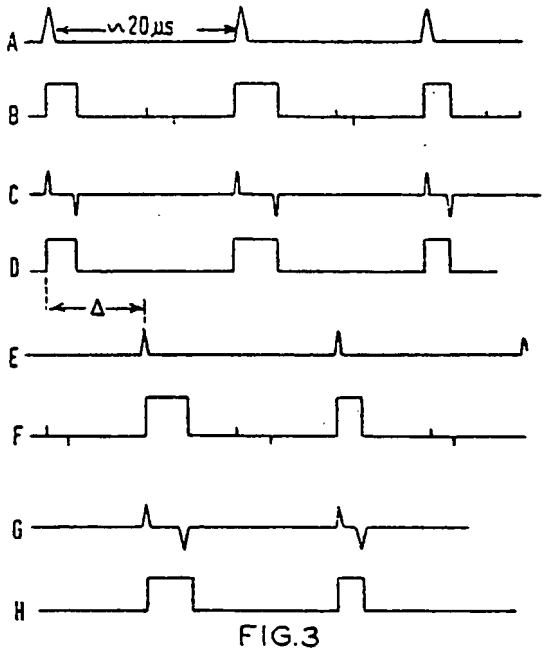

A
≈20μs
B
C
D
Δ
E
F
G
H

FIG.3

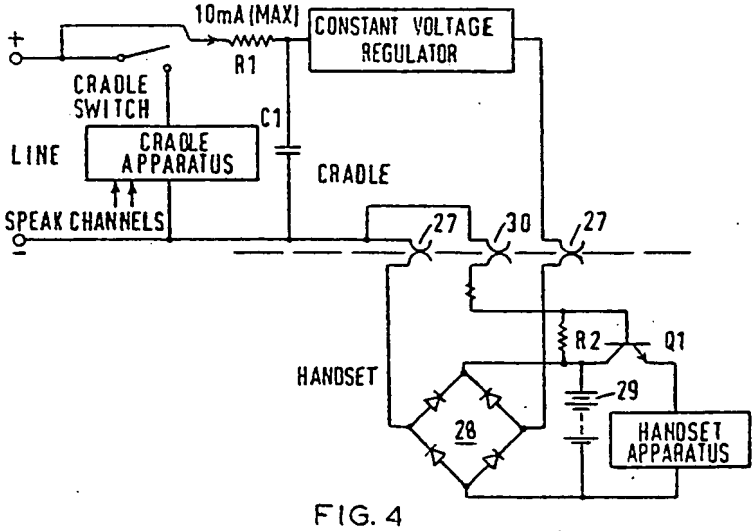

10mA (MAX)
CONSTANT VOLTAGE REGULATOR
R1
CRADLE SWITCH
C1
LINE
CRADLE APPARATUS
CRADLE
SPEAK CHANNELS
27
30
27
R2
Q1
HANDSET
29
28
HANDSET APPARATUS

FIG. 4

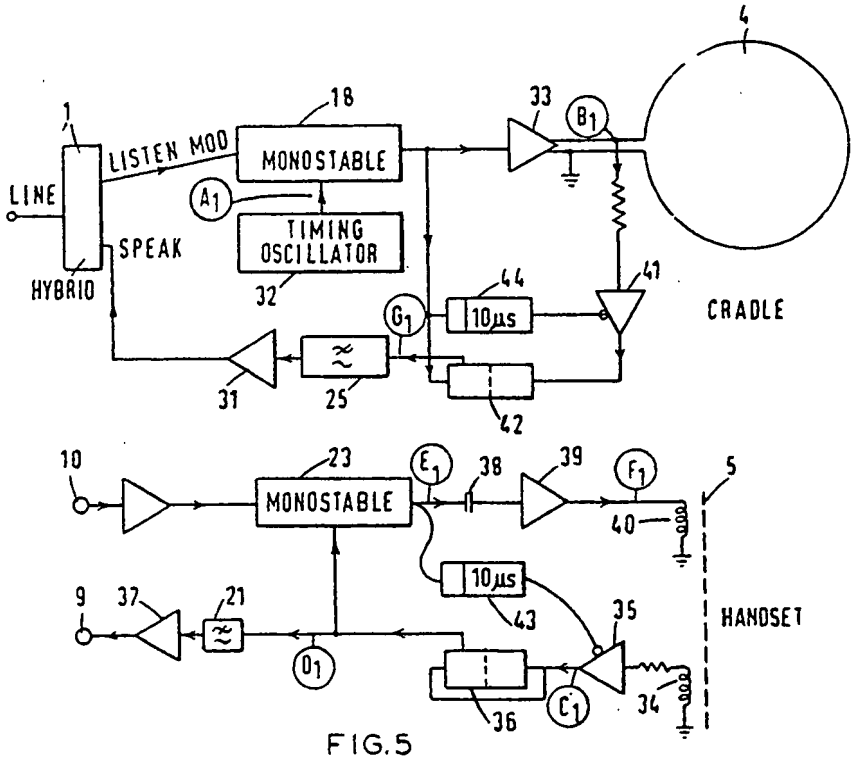

4
1
LISTEN MOD
LINE
SPEAK
HYBRID
18
MONOSTABLE
A1
TIMING OSCILLATOR
32
33
B1
CRADLE
44
10µs
G1
41
31
25
42
10
23
MONOSTABLE
E1
38
39
F1
5
40
10µs
43
9
37
21
D1
35
HANDSET
C1
34
36

FIG.5

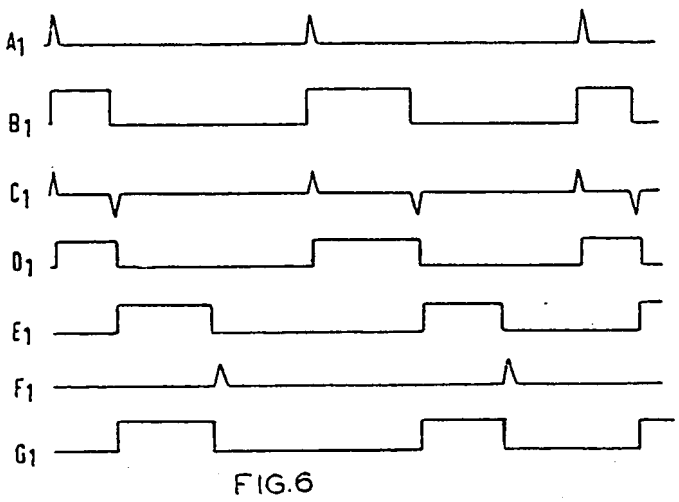
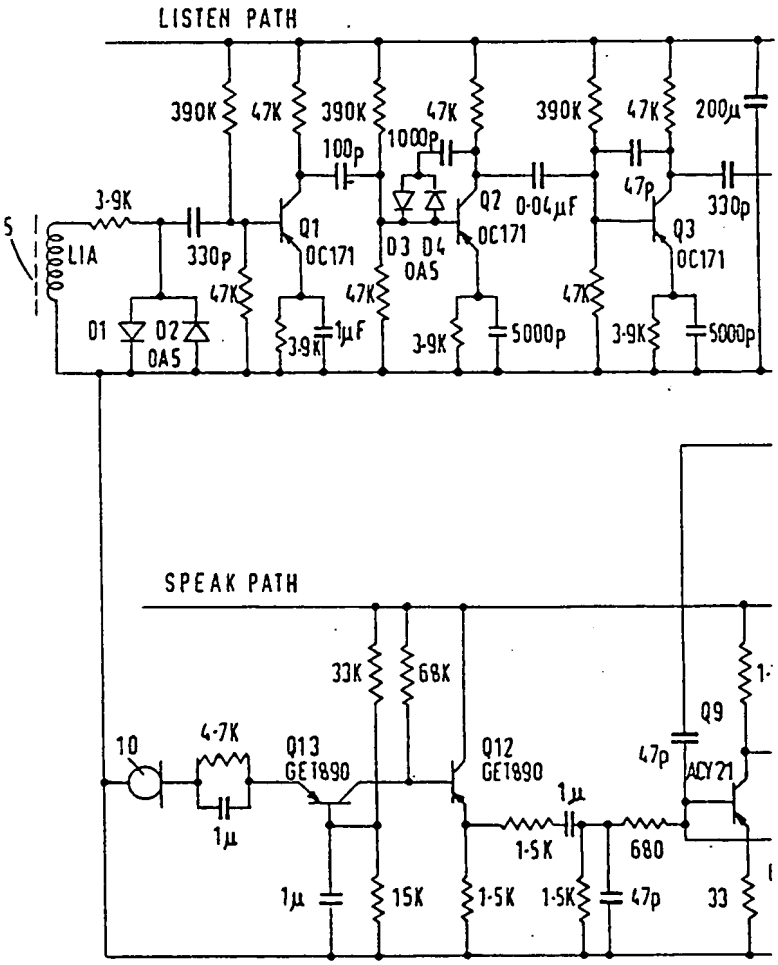

A1
B1
C1
D1
E1
F1
G1

FIG.6


LISTEN PATH
390K
47K
390K
47K
1000p
100p
390K
47K
200µ
3·9K
330p
Q1
OC171
Q2
0·04µF
47p
330p
S
L1A
330p
D3 D4
OA5
OC171
Q3
OC171
47K
47K
47K
D1
D2
OA5
3·9K
1µF
3·9K
5000p
3·9K
5000p
SPEAK PATH
33K
68K
10
4·7K
Q13
GET890
Q12
GET890
Q9
47p
ACY21
1µ
1µ
1·5K
680
1µ
15K
1·5K
1·5K
47p
33

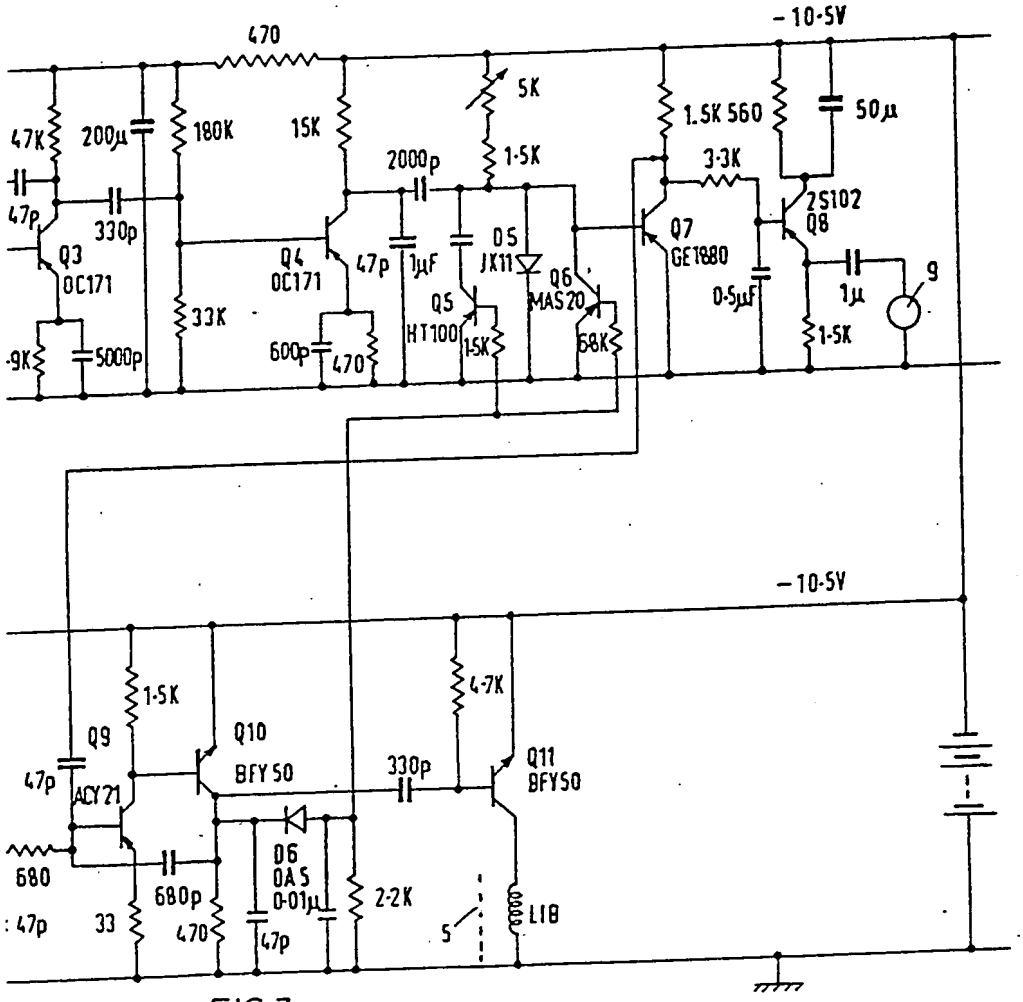

-10·5V
470
5K
47K
200µ
180K
15K
2000p
1·5K
1·5K 560
50µ
3·3K
47p
330p
Q3
OC171
Q4
OC171
47p
1µF
OS
JK11
Q6
MAS20
Q7
GE1880
2S102
Q8
0·5µF
1µ
9
33K
9K
5000p
600p
470
Q5
HT100
1·5K
68K
1·5K
-10·5V
1·5K
4·7K
Q9
47p
ACY21
Q10
BFY50
330p
Q11
BFY50
680
680p
33
470
D6
OA5
0·01µ
47p
2·2K
5
L18
47p

FIG.7

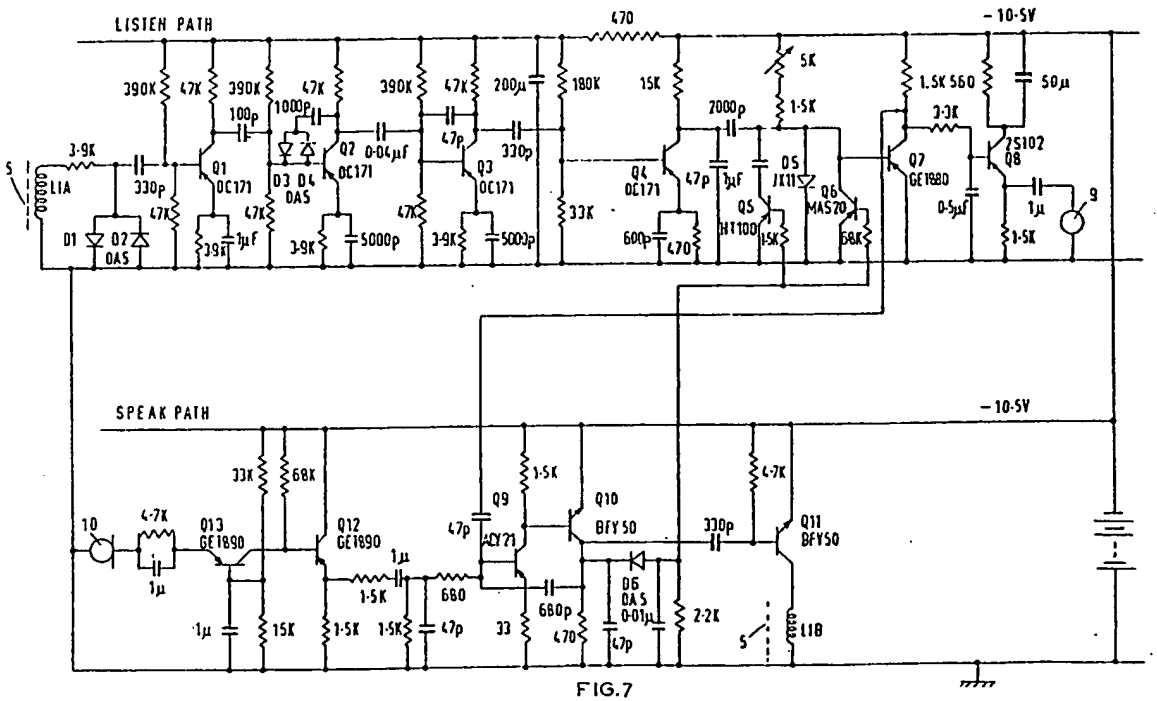
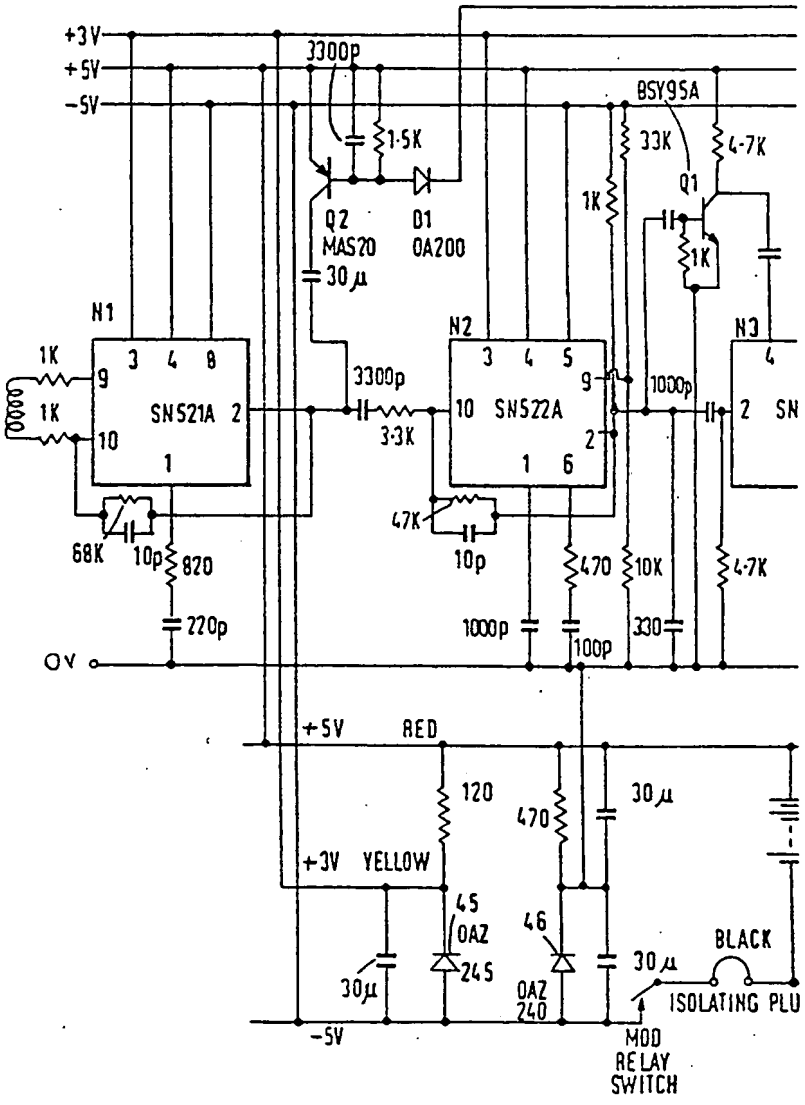
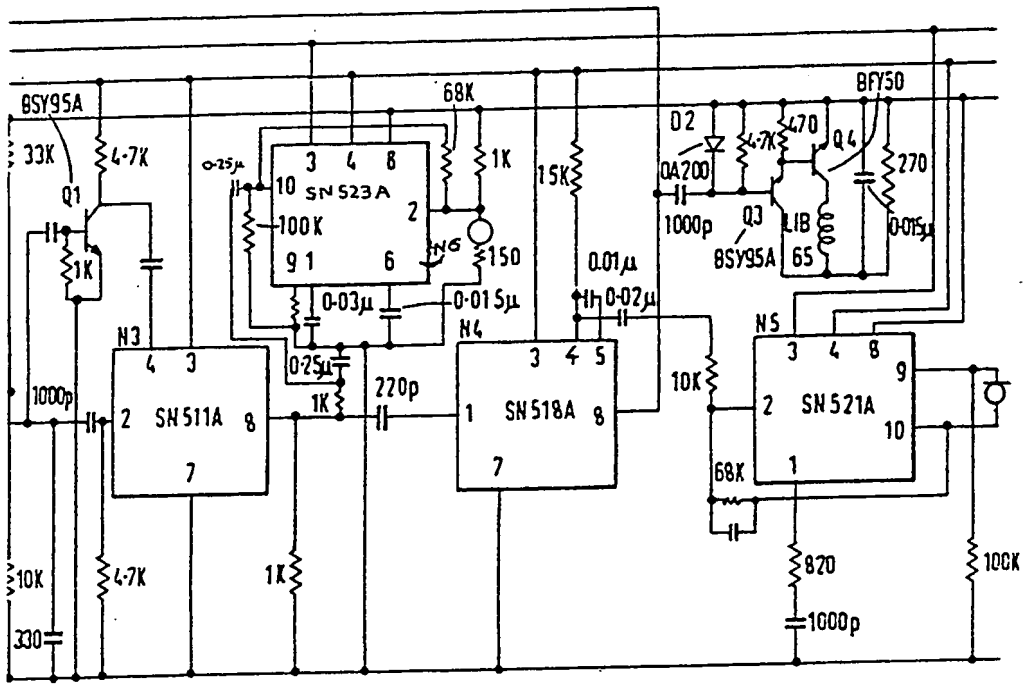

LISTEN PATH
SPEAK PATH
-10·5V
470
5K
1·5K
2000p
180K
15K
33K
200µ
100p
1000p
330p
47p
1µF
0·04µF
0·5µF
50µ
1µ
5000p
600p
680p
680
2·2K
0·01µ
1·5K 560
3·3K
2S102
Q8
Q7
GE1880
Q6
MAS70
Q5
HT100
Q4
OC171
Q1
OC171
Q2
OA5
Q3
OC171
Q7
0·04µF
D3 D4
OA5
D5
JX11
D6
OA5
Q9
ACY21
Q10
BFY50
Q11
BFY50
Q12
GE1890
Q13
GE1890
LIA
S
9
10
11
390K
47K
3·9K
68K
4·7K
15K
33
118

FIG.7


+3V
+5V
-5V
3300p
1·5K
BSY95A
33K
4·7K
Q1
1K
Q2
MAS20
D1
OA200
30µ
1K
N1
N2
N3
1K
3
4
8
9
1K
10
SN521A
2
1
3300p
3·3K
3
4
5
9
10
SN522A
2
1
6
1000p
2
SN
4
47K
10p
68K
10p
820
220p
470
10K
4·7K
1000p
100p
330
0V
+5V
RED
120
470
30µ
+3V
YELLOW
45
OAZ
245
46
OAZ
240
30µ
30µ
BLACK
ISOLATING PLU
-5V
MOD
RELAY
SWITCH


BSY95A
33K
4·7K
Q1
1K
0·25μ
3 4 8
10 SN523A 2
100K
9 1 6
NS
68K
1K
150
0·03μ
0·015μ
N3
4 3
2 SN511A 8
7
0·25μ
1K
220p
N4
3 4 5
1 SN518A 8
7
15K
0·01μ
0·02μ
D2
OA200
1000p
4·7K
470
Q4
BFY50
270
Q3
BSY95A
LIB
65
0·015μ
N5
3 4 8
9
2 SN521A
10
1
10K
68K
820
1000p
100K
1000p
10K
4·7K
1K
330

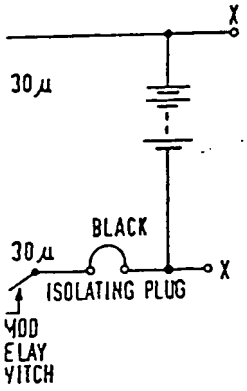

X
30μ
BLACK
30μ
X
ISOLATING PLUG
400
ELAY
YITCH

FIG. 8

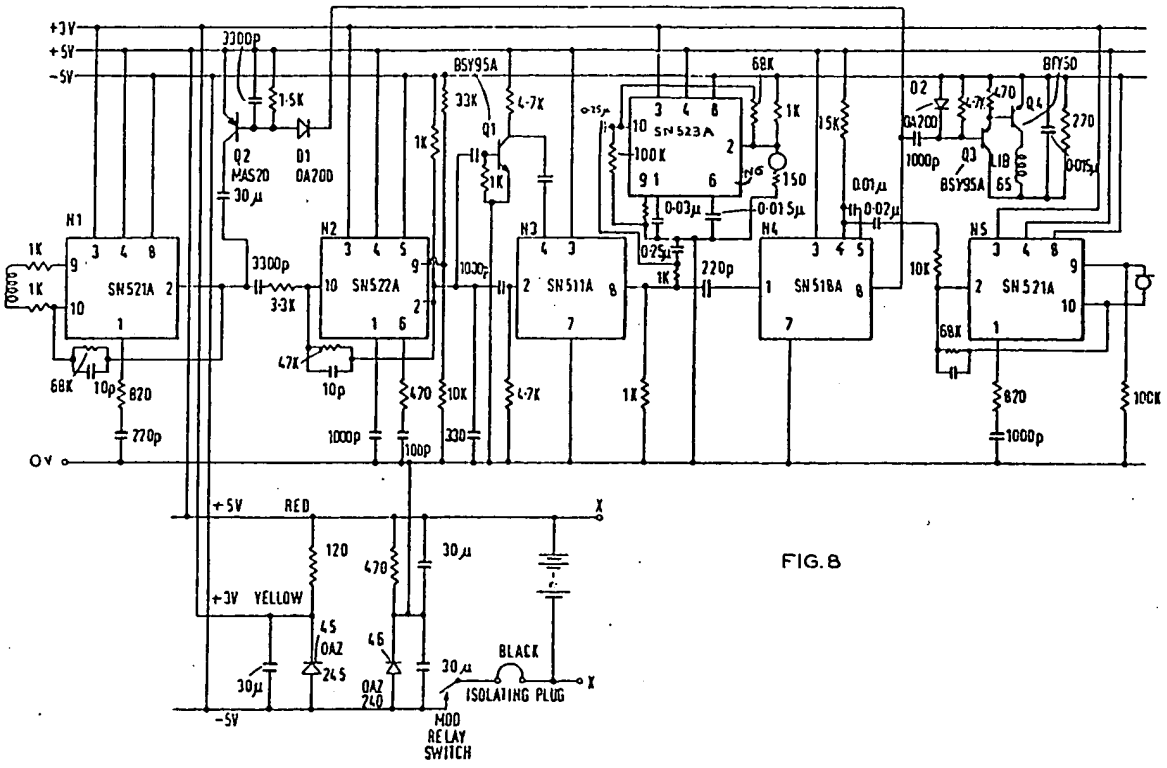
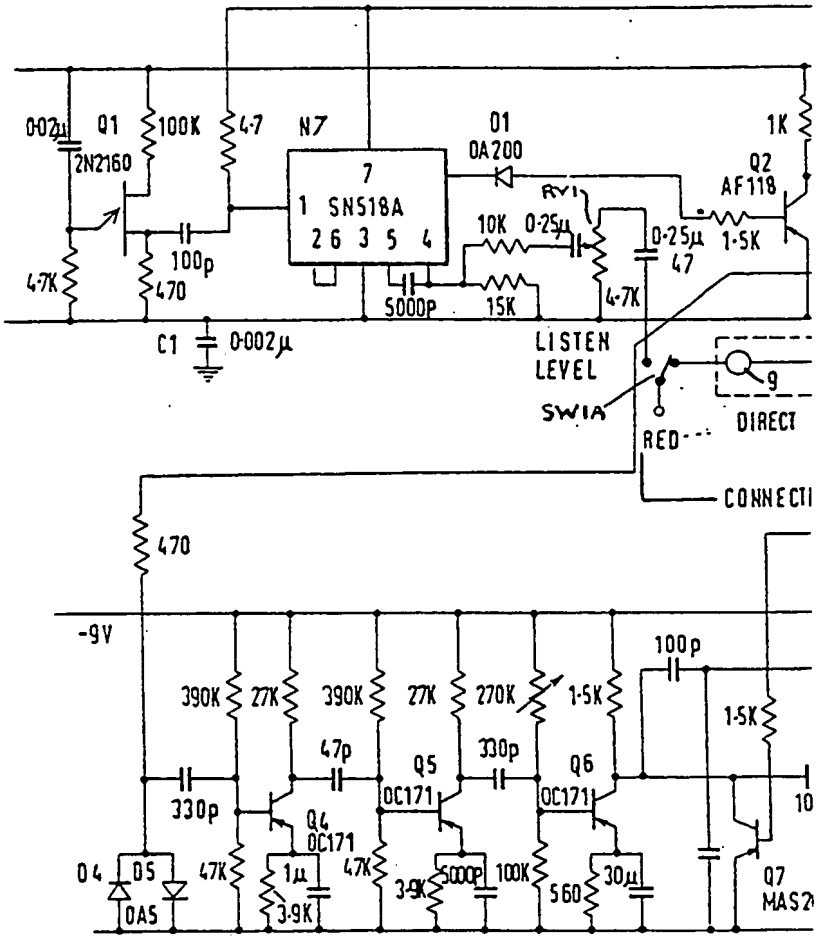

+3V
+5V
-5V
0V
3300p
1·5K
BSY95A
33K
4·7K
Q1
Q2
MAS70
D1
OA70D
30μ
1K
N1
SN521A
N2
SN522A
N3
SN511A
N4
SN523A
N5
SN521A
N6
SN518A
68K
10p
820
270p
3300p
3·3K
47K
1000p
100p
470
10K
330
1030p
0·25μ
100K
150
0·03μ
0·015μ
0·075μ
220p
15K
0·01μ
0·02μ
Q2
OA200
Q3
BSY95A
Q4
BFY50
LIB
65
270
0·015μ
+5V RED
X
+3V YELLOW
120
470
30μ
45
OAZ
245
46
OAZ
240
BLACK
ISOLATING PLUG
-5V
MOD
RELAY
SWITCH

FIG. 8


0·02μ
Q1
2N2160
100K
4·7
N7
7
1 SN518A
2 6 3 5 4
D1
OA200
RV1
1K
Q2
AF118
10K
0·25μ
0·25μ
47
1·5K
4·7K
100p
470
5000P
15K
4·7K
C1
0·002μ
LISTEN
LEVEL
SWIA
9
DIRECT
RED
CONNECTI
470
-9V
390K
27K
390K
27K
270K
1·5K
100p
1·5K
47p
330p
330p
Q5
OC171
Q6
OC171
Q4
OC171
D4
D5
OA5
47K
1μ
3·9K
47K
3·9K
5000P
100K
560
30μ
Q7
MAS2
10

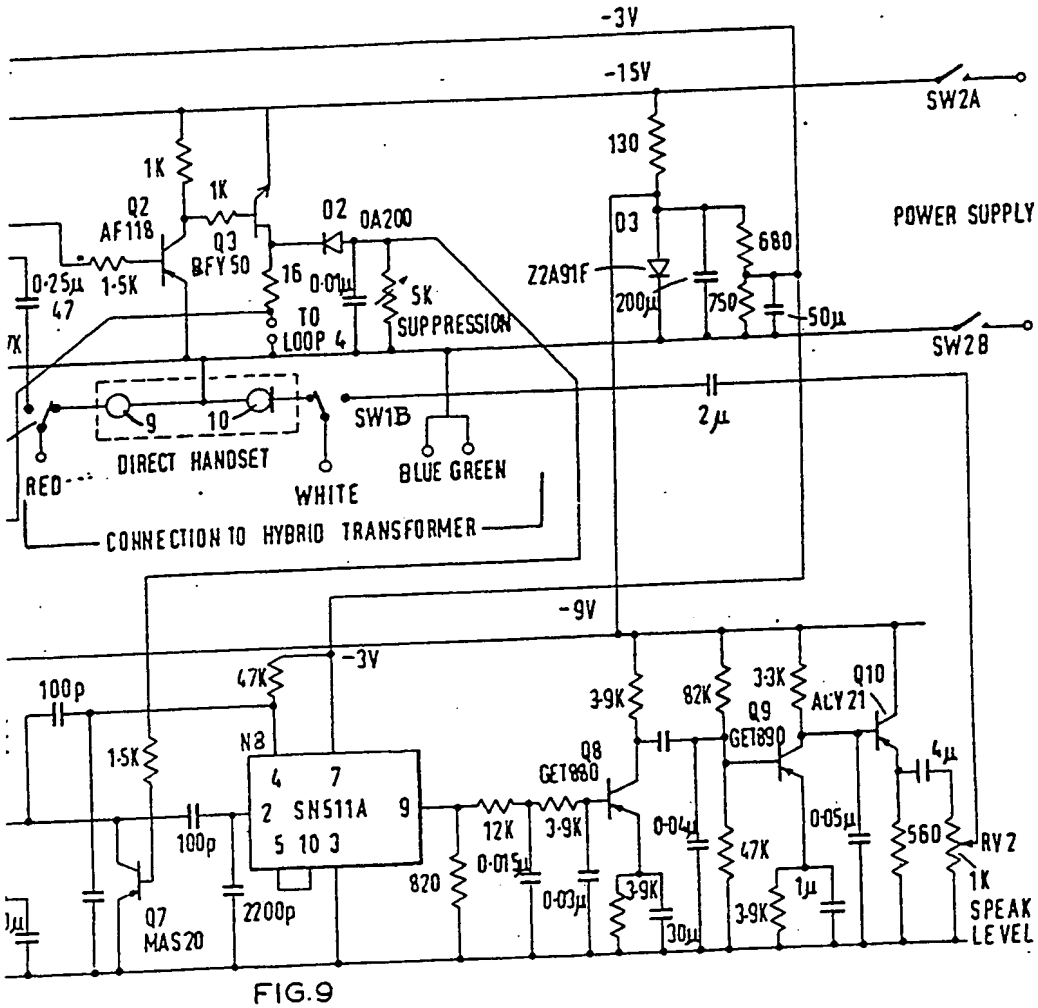

-3V
-15V
SW2A
130
1K
1K
Q2
AF118
Q3
BFY50
D2
OA200
D3
POWER SUPPLY
680
Z2A91F
200µ
750
50µ
SW2B
0·25µ
47
1·5K
16
0·01µ
5K
SUPPRESSION
TO
LOOP 4
9
10
SW1B
2µ
DIRECT HANDSET
RED
WHITE
BLUE GREEN
CONNECTION TO HYBRID TRANSFORMER
-9V
-3V
100p
47K
3·9K
82K
3·3K
Q10
ACY21
Q9
GET880
N8
4 7
2 SN511A 9
5 10 3
Q8
GET880
4µ
1·5K
100p
12K
3·9K
0·04µ
0·05µ
560
RV2
1K
SPEAK
LEVEL
820
0·015µ
0·03µ
3·9K
30µ
47K
3·9K
1µ
Q7
MAS20
2200p

FIG.9

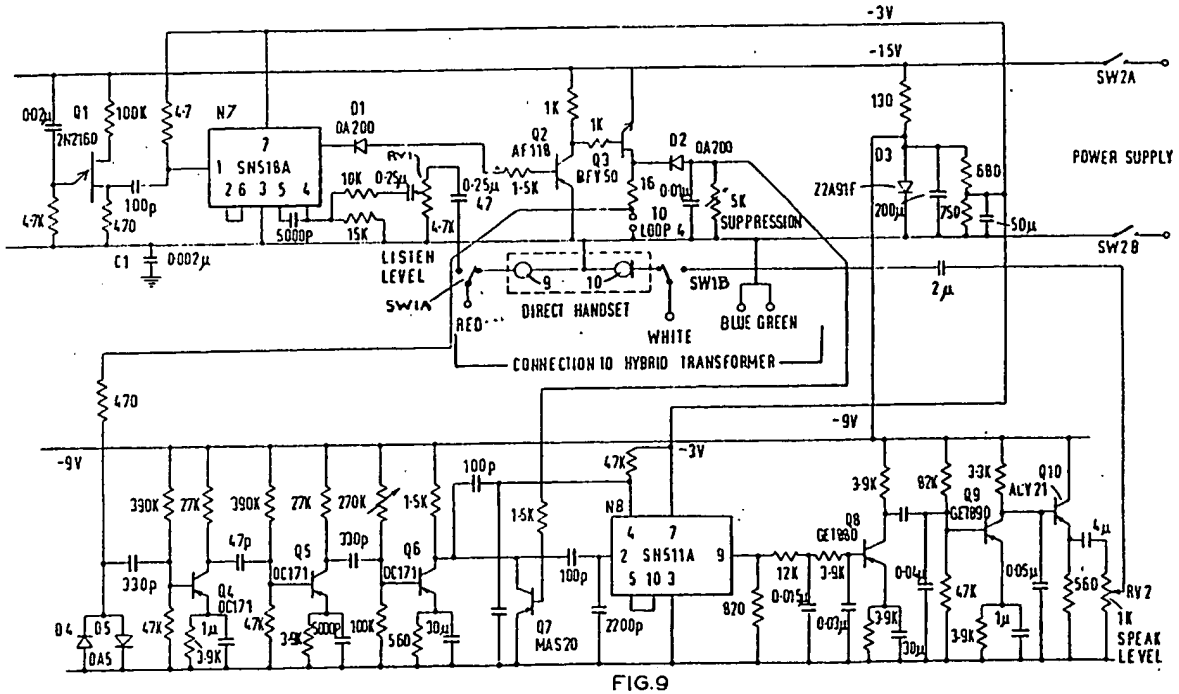

-3V
-15V
SW2A
POWER SUPPLY
SW2B
0·02µ
Q1
2N2160
100K
4·7
N7
SNS18A
Q1
OA200
Q2
AF118
Q3
BFY50
D2
OA200
1K
1K
130
D3
22A91F
200µ
680
750
50µ
10K
0·25µ
0·25µ
47
1·5K
4·7K
16
0·01µ
10
LOOP 4
5K
SUPPRESSION
100p
470
4·7K
5000p
15K
C1
0·002µ
LISTEN
LEVEL
SW1A
SW1B
9
10
DIRECT HANDSET
RED
WHITE
BLUE GREEN
2µ
CONNECTION TO HYBRID TRANSFORMER
470
-9V
-3V
330K
77K
390K
77K
270K
1·5K
100p
47K
1·5K
N8
SNS11A
3·9K
82K
3·3K
Q9
GET890
Q10
ACY21
4µ
330p
47p
330p
Q5
OC171
Q6
OC171
Q4
OC171
Q8
GET880
12K
3·9K
0·04µ
0·05µ
D4
D5
OA5
47K
1µ
3·9K
47K
3·9K
5000p
100K
560
10µ
Q7
MAS20
2200p
100p
870
0·015µ
0·03µ
3·9K
30µ
47K
3·9K
1µ
560
RV2
1K
SPEAK
LEVEL

FIG.9